IAN STIRLING

Biological studies of the Southern Ocean: research plans and international coordination

POLAR
PAM
2807
POLARPAM

BIOLOGICAL INVESTIGATIONS OF
MARINE ANTARCTIC SYSTEMS
AND STOCKS (BIOMASS)

BIOLOGICAL STUDIES OF THE SOUTHERN OCEAN: RESEARCH PLANS AND INTERNATIONAL COORDINATION

Sayed Z. El-Sayed
Department of Oceanography
Texas A&M University

SEPTEMBER 1986
Published by SCAR and SCOR
Printed at Texas A&M University
College Station, Texas

Rec'd: DEC 11 1986
Order No.:
Price: GFG
Acc. No: Dr. Stirling.

BOREAL INSTITUTE
LIBRARY

FOREWORD

In April 1986, Dr. R.M. Laws, Chairman of the SCAR Working Group on Biology, requested that I prepare a background paper on future biological studies of the Southern Ocean for discussion at the meeting of his group, held in conjunction with XIX SCAR in San Diego, California, in June 1986. The paper was tabled and discussed during the meetings of the Biology WG and the BIOMASS Executive Committee. At the latter meeting, it was agreed that the paper provided a succinct summary of the various activities of the international organizations with interest in studies of the Southern Ocean ecosystems and their living resources and presented a useful outline of future biological research during the next decade or so, whereupon the Executive recommended its publication and distribution as one of the BIOMASS publications.

The views expressed in this paper are solely those of the author and do not necessarily reflect those of the BIOMASS Executive or SCAR.

I am indeed grateful to my colleagues who reviewed and commented on the paper in its various draft stages.

S. Z. El-Sayed, Chairman
BIOMASS Executive Committee

College Station, Texas
July 1986

Biological Studies of the Southern Ocean:
Research Plans and International Coordination

Sayed Z. El-Sayed
Department of Oceanography
Texas A&M University

FOREWORD i

I. INTRODUCTION 1

II. INTERNATIONAL ORGANIZATIONS WITH INTEREST IN STUDIES OF THE SOUTHERN OCEAN ECOSYSTEMS AND THEIR LIVING RESOURCES 3

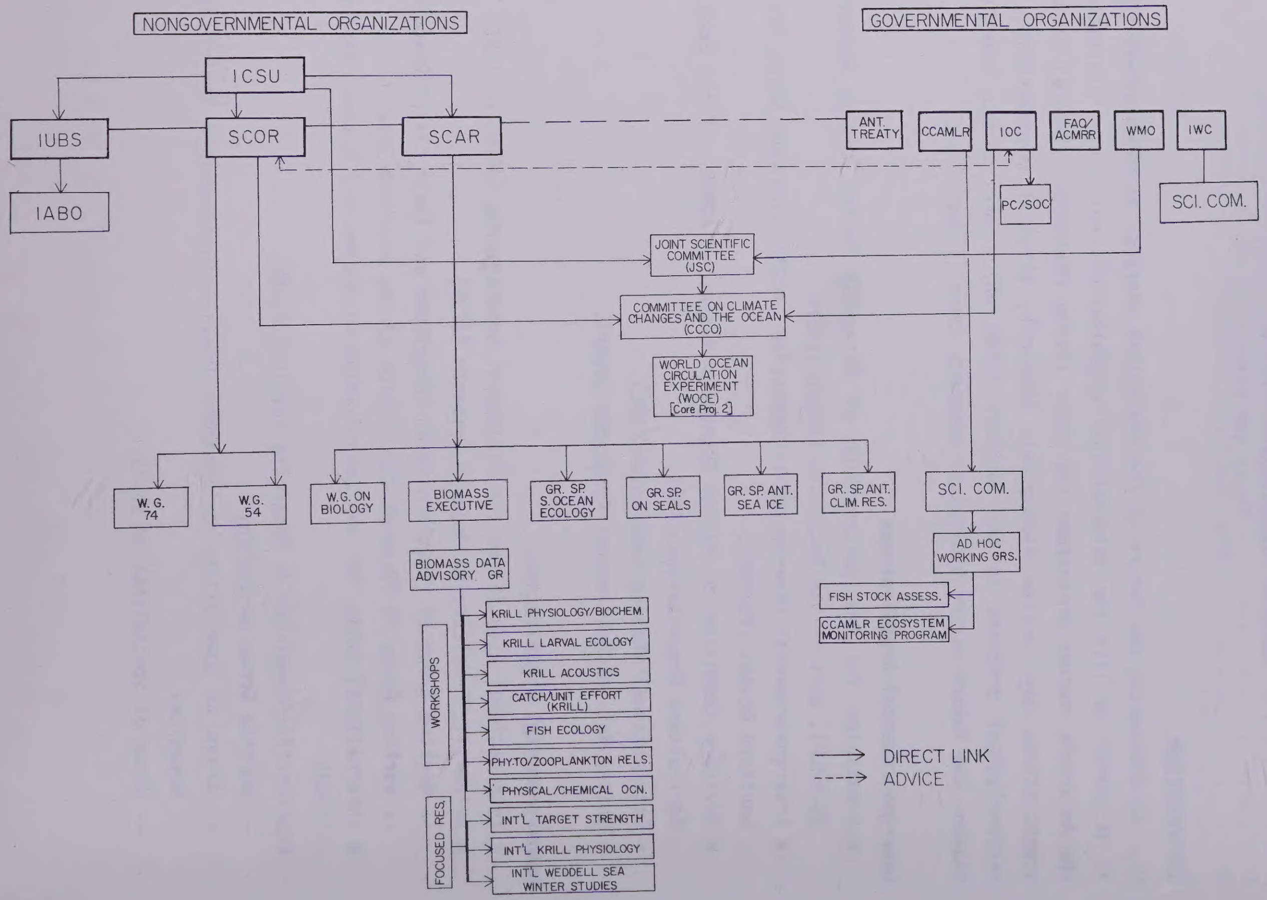
- **A. Intergovernmental Organizations** 3
  - 1. Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) 3
  - 2. Intergovernmental Oceanographic Commission (IOC)/Programmme Group for the Southern Oceans 4
  - 3. Advisory Committee on Marine Resources Research (ACMRR) of the Food and Agriculture Organization 4
  - 4. International Whaling Commission (IWC) 5
  - 5. United Nations Environment Programme (UNEP) 5

- **B. Nongovernmental Organizations** 5
  - 1. International Association for Biological Oceanography (IABO) 5
  - 2. Scientific Committee on Oceanic Research (SCOR) 5
    - a. Working Group 54 5
    - b. Working Group 74 6
  - 3. International Union for the Conservation of Nature and Natural Resources (IUCN) 6
  - 4. Scientific Committee on Antarctic Research (SCAR) 7
    - a. Biology Working Group 7
    - b. Group of Specialists on Southern Ocean Ecosystems and Their Living Resources 7
    - c. Group of Specialists on Seals 8
    - d. Group of Specialists on Antarctic Sea Ice (ASI) 8
    - e. Group of Specialists on Antarctic Climate Research (ACR) . . . 8

III. FUTURE BIOLOGICAL STUDIES OF THE SOUTHERN OCEAN 8

- **A. Building on the Results of the BIOMASS Program** 9
  - 1. Krill Physiology and Biochemistry 9
  - 2. Fish Ecology 11
  - 3. Krill Larval Ecology 11
  - 4. Catch per Unit of Effort (CPUE) as an Estimator of Krill Abundance 11
  - 5. Phytoplankton/Zooplankton Relationships 11
  - 6. Physical and Chemical Oceanography 11
  - 7. Krill Acoustics 11
- **B. Toward a "More Focused" Post-BIOMASS Program** 12
  - 1. International Target Strength Study 12
  - 2. International Krill Physiology Project 12
  - 3. International Weddell Sea Winter Studies 12

ORGANIZATIONAL STRUCTURE FOR SOUTHERN OCEAN STUDIES



-- Group of Specialists on Antarctic Sea Ice (ASI)
-- Group of Specialists on Antarctic Climate Research (ACR)
-- Group of Specialists on Southern Ocean Ecology.

IABO/IUBS, SCOR and SCAR are components of the International Council of Scientific Unions (ICSU).

A brief outline of the interests and activities of these organizations in regard to Southern Ocean ecosystems and their living resources follows.

INTERNATIONAL ORGANIZATIONS WITH INTEREST IN THE STUDIES OF SOUTHERN OCEAN ECOSYSTEMS AND THEIR LIVING RESOURCES

Intergovernmental Organizations

Commission and Scientific Committee for the Conservation of Antarctic Marine Living Resources (CCAMLR)

The Convention on the Conservation of Antarctic Marine Living Resources came into force in April 1982. The Convention provides the essential legal framework for management of the living resources of the Southern Ocean. The objective of the Convention is conservation; it specifically includes the concept of rational use of the resources. CCAMLR established both a **Commission** and a **Scientific Committee.** The Scientific Committee has the task of providing information and management advice about a complex ecosystem. To accomplish this task, the Committee oversees the collection, analysis, and reporting of a broad spectrum of data which includes fishery statistics, biological attributes and status of target and nontarget species, characteristics of the physical environment and ecological relations among living resources and their environment. To help achieve its goals, the Scientific Committee, among other things, is now developing a long-term program of work to guide its activities.

The **Scientific Committee** of CCAMLR holds annual meetings to which representatives from IUCN, IOC, IWC, ACMRR/FAO, SCAR, and SCOR are invited. The Scientific Committee has the following subsidiary bodies:

- *ad hoc* Working Group on Fish Stock Assessment
- Working Group for the CCAMLR Ecosystem Monitoring Program.

IOC/Programme Group for the Southern Oceans

Intergovernmental Oceanographic Commission (IOC) has a subsidiary body called Programme Group for the Southern Oceans (PG/SOC) (successor to the **Coordination Group for the Southern Oceans**, established in 1970). It is composed of IOC member states interested in marine Antarctic research, with observers from SCOR, SCAR, ACMRR (FAO), and other interested organizations. The group is concerned with all aspects of Southern Ocean studies and maintains close coordination with SCAR and SCOR and other bodies interested in the Southern Ocean.

As an indication of interest in the Southern Ocean, IOC/PG/SOC sponsored a meeting of **Experts on Oceanography Related to the Dynamics of the Antarctic Ecosystem** in May 1984 at the Institut fur Meereskunde, Kiel, F.R.G., which was attended by SCOR WG 74 members and several members of the SCAR Group of Specialists on Southern Ocean Ecosystems and Their Living Resources.

This meeting was conducted to achieve three main goals:

(1) to inform the members of SCOR WG 74 of the work and results obtained during the First International BIOMASS Experiment (FIBEX) and Second International BIOMASS Experiment (SIBEX),

(2) to discuss what physical and chemical oceanographic processes relevant to the Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS) objectives should be studied through international cooperation, and

(3) to develop plans for related seagoing activities.

Further, IOC is cosponsoring (with CCAMLR, SCAR, and SCOR) the **Scientific Symposium on Antarctic Ocean Variability and Its Influence on Marine Living Resources, Particularly Krill,** to be held in Paris, 2-6 June 1987.

Advisory Committee on Marine Resources Research (ACMRR) of FAO

The Food and Agriculture Organization (FAO) has direct interest in the resources of the Southern Ocean and is already active in several spheres. Its main interests are in the better utilization and management of these resources rather than in scientific research in the narrow sense. FAO with support from UNEP has produced Draft **Global Action Plan for Marine Mammals** which addresses some Antarctic species. Beside providing STATLANT Forms (used for reporting catch data to FAO), FAO published in 1985 two volumes of **Species Identification Sheets**. For the Southern Ocean these include seaweeds, euphausiids, crabs, molluscs, hagfish and lampreys, sharks and rays, bony fishes, and marine mammals. The species selected for inclusion in the publications include those known to be of present or potential commercial interest, species taken as by catch, or species requiring special protection.

International Whaling Commission (IWC)

The IWC has launched an **International Decade of Cetacean Research** in response to proposals from UNEP and others. IWC has also embarked on a new management policy for whaling by its member states that requires considerably expanded research for effective application. A moratorium on commercial whaling became effective in 1986, and IWC is presently planning a comprehensive assessment scheduled to be done by 1990.

United Nations Environment Programme (UNEP)

UNEP has a wide interest in environmental affairs, including the conservation of natural resources. It has helped support the ACMRR (FAO) study of marine mammals mentioned above.

Nongovernmental Organizations

International Association for Biological Oceanography (IABO)

IABO was one of the early cosponsors of the BIOMASS program. However, its interests in and support of the program has been peripheral in recent years.

Scientific Committee on Oceanic Research (SCOR)

Working Group 54 (Also known as SCAR Group of Specialists on Southern Ocean Ecosystems and Their Living Resources). SCOR joined SCAR in establishing this group as one of the main sponsors of the BIOMASS program. SCOR has been very supportive of the various activities of WG 54.

Working Group 74 (General Circulation of the Southern Ocean). This group has been charged with the identification of major gaps in our knowledge of the general circulation of the Southern Ocean, bearing in mind its relevance to biology and climate. The Group has been interacting with members of the IOC Programme Group on the Southern Oceans (PG/SOC) as well as with SCOR WG 54. As mentioned earlier, members of SCOR WG 74 participated in the meeting of Experts on Oceanography Related to the Dynamics of the Antarctic Ecosystem sponsored by IOC/PG/SOC in 1984.

Recent activities of WG 74 have included: discussions regarding the proposed **Scientific Symposium on Antarctic Ocean Variability and Its Influence on Marine Living Resources, Particularly Krill**; discussions and correspondence with several scientists regarding the future of Antarctic marine ecosystem research; and discussions with the Chairman of WG 54 regarding future approaches by SCOR and SCAR to providing advice on physical, chemical, and biological studies in the Southern Ocean.

Although WG 74 has completed its work, SCOR has agreed to keep WG 74 in existence until 1986 to provide, as appropriate, advice and representation on behalf of SCOR regarding physical and chemical oceanography of the Southern Ocean. The group will be disbanded at the XVIII General Meeting of SCOR in November 1986.

International Union for the Conservation of Nature and Natural Resources (IUCN)

In 1981, IUCN, with support from the United Nations Environmental Programme (UNEP) and the **World Wildlife Fund (WWF)**, launched its **World Conservation Strategy** simultaneously in 32 countries. The question of the resources of the Southern Ocean was discussed. In recent years, IUCN has shown greater interest in the conservation of the Antarctic living resources. This is reflected in the **Joint IUCN/SCAR Symposium on the Scientific Requirements for Antarctic Conservation** which was held in Bonn, F.R.G., 22-26 April 1985. The aim of the symposium was to review present knowledge of the ecology of the Antarctic continent, its surrounding waters and its offshore islands, specifically in the context of conservation needs in the region.

Scientific Committee on Antarctic Research (SCAR)

Working Group on Biology. The WG Biology has long been interested in the fauna and flora of the waters surrounding Antarctica. Two of its active subsidiary groups are the **Subcommittee on Bird Biology** and the **Subcommittee on Conservation.** The SCAR Group of Specialists on Southern Ocean Ecosystems and Their Living Resources (see below) arose as a subcommittee of the Biology Working Group.

Group of Specialists on Southern Ocean Ecosystems and Their Living Resources (Also known as SCOR Working Group 54). In 1972 the WG Biology established a **Subcommittee on the Living Resources of the Southern Ocean.** In 1976 the subcommittee was upgraded to a **Group of Specialists on Southern Ocean Ecosystems and Their Living Resources.** Also in 1976, SCAR and SCOR sponsored the **First International Symposium on Living Resources of the Southern Ocean** which was held in Woods Hole, Massachusetts, U.S.A.

An outcome of this symposium was the publication by the Group of Specialists of an important document, **Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS)*** which outlined a ten-year collaborative international research program. The objective of BIOMASS was "to gain a deeper understanding of the structure and dynamic functioning of the Antarctic marine ecosystem as a basis for the management of actual and potential living resources." The BIOMASS program had two major aims:

(a) to contribute to mankind's understanding of the Southern Ocean and its biota;

(b) to develop a sound ecological strategy for the exploitation of the living resources and for the conservation of the Antarctic marine ecosystem.

---

* See: Biological Investigations of Marine Antarctic Systems and Stocks, Vol. 1: Research Proposals (1977), S.Z. El-Sayed, editor.

The Group of Specialists was responsible for the planning and execution of the First International BIOMASS Experiment (**FIBEX**) in 1981/82 and the Second International BIOMASS Experiment (**SIBEX**) in 1983/84 and 1984/85. One of the crowning achievements of the Group of Specialists was the establishment in 1984 of the BIOMASS Data Centre in Cambridge, U.K. With the disbanding of the Group of Specialists in 1985, the BIOMASS Executive Committee has now assumed the responsibility of overseeing the successful completion of BIOMASS data analysis phase by 1989.

Group of Specialists on Seals. This Group of Specialists is charged with encouraging and coordinating research on Antarctic seals, reviewing the status of seal stocks, compiling information on the annual take of seals for scientific and other purposes, and, through SCAR, providing advice to the Antarctic Treaty Consultative Parties on measures needed to meet the objectives of the Convention for the Conservation of Antarctic Seals.

Group of Specialists on Antarctic Sea Ice (ASI) (Cosponsored by SCOR). This newly formed group has formulated a ten-year program for an international cooperative study of the Antarctic Sea Ice Zone. The biological component of the program deals primarily with the study of the pack-ice ecosystem.

Group of Specialists on Antarctic Climate Research (ACR). This group was established to plan and coordinate an Antarctic component to the **World Climate Research Programme.** Among the planned research activities recommended by the group are systematic sea ice observations from satellites and from ships engaged in biological and other research.

FUTURE BIOLOGICAL STUDIES OF THE SOUTHERN OCEAN

Recent intensification of interest in the Antarctic marine ecosystem in general and its living resources in particular, together with the completion of the field phase of the international BIOMASS program (i.e., FIBEX and SIBEX) and the disbanding of the Group of Specialists on Southern Ocean Ecosystems and Their Living Resources, has left Antarctic marine biologists standing at crossroads. The direction and focus of future research will, in large measure, be determined by decisions concerning the nature of biological oceangraphic research in the Southern Ocean envisioned as most important within the next 15-20 years and should take into consideration the outcome of the series of workshops/meetings and the final synthesis and review of the results of the BIOMASS program (see below). This section explores a few options that the Antarctic marine biological community has at this juncture.

Building on the Results of the BIOMASS Program

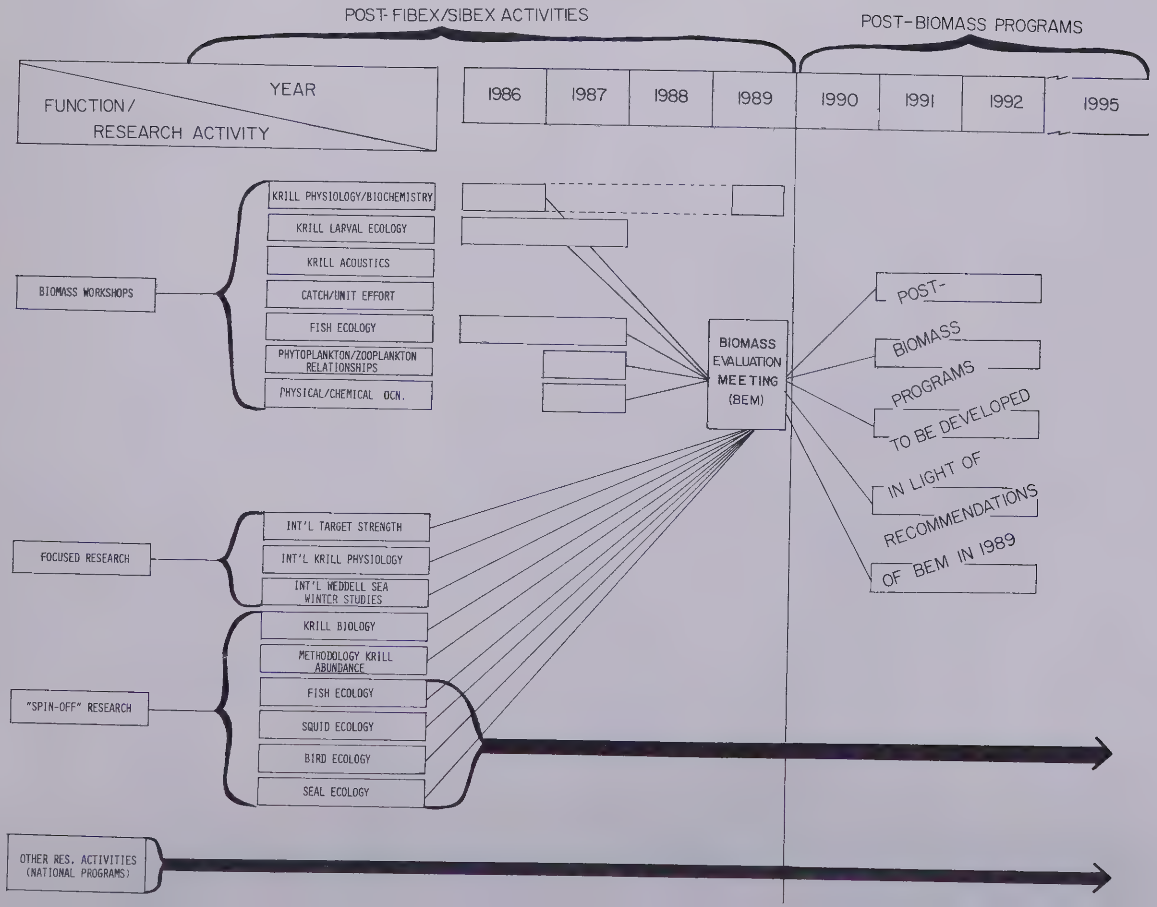
The BIOMASS program was the first major international collaborative effort to study the Antarctic marine ecosystem and to provide the necessary information for the wise management of the marine living resources.

With the successful completion of FIBEX and SIBEX and the establishment of the BIOMASS Data Centre in Cambridge, U.K., the BIOMASS program has now entered a final phase of data analysis and data interpretation. To ensure that full advantage is taken of the enormous amount of data collected, further evaluation of the existing data is necessary. To this end, a series of workshops is being planned to process and evaluate information and to report on findings. These workshops will be both disciplinary (i.e., krill, fish, birds, etc.) and interdisciplinary (e.g., ecosystem modeling) in nature. A final meeting to evaluate the decade of BIOMASS (1976-1986) is planned for 1989 (Figure 2).

A description of **the BIOMASS Data Analysis Workshops** to be held between 1986 and 1989 follows.

Krill Physiology and Biochemistry. Two workshops are planned. The objective of these workshops is to focus on future areas for research through an exchange of information about current krill research projects. Proposed topics include: reproduction, feeding, moulting, oxygen consumption, seasonal biochemistry, energetics of larval development, and lipofuscins and their value in age determination. The function of the first workshop will be to discuss current research and decide upon topics most in need of attention. The second workshop (3-4 years later) will be to review the results of subsequent studies.

PROJECTED BIOMASS-RELATED ACTIVITIES (1986-1995)



Fish Ecology. Workshop objectives are to validate SIBEX data oriented to ichthyoplankton, including mesopelagic fish, and formulate objectives for a final evaluation workshop.

Krill Larval Ecology. The purpose of this workshop will be to determine the factors controlling the distribution of krill larvae and the characteristics of areas of krill larval abundance.

Catch per Unit of Effort (CPUE) as an Estimator of Krill Abundance. The goals of this workshop, which is being planned by the CCAMLR Scientific Committee, are to determine the extent to which CPUE of individual vessels and fleets can be used as an estimator of abundance over large-scale areas of the Southern Ocean.

Phytoplankton/Zooplankton Relationships. This workshop will focus on: species as indicators of water masses; vertical and horizontal patchiness of organisms; distribution in relation to bottom topography; interactions between species; seasonal and annual variation of species composition and biomass; and relation between phytoplankton and zooplankton.

Physical and Chemical Oceanography. Objectives of this workshop are to analyze SIBEX oceanographic data and prepare the results in a form which may be used during the interpretation of SIBEX biological data. The evaluation of results will include qualitative and quantitative descriptions of physical phenomena of probable ecological significance as well as seasonal and annual variations in these phenomena.

Krill Acoustics. The purpose of this workshop will be to analyze SIBEX krill abundance data once they are added to the data base and validated.

As was mentioned earlier, the results/recommendations of these workshops will help to determine the focus and direction of marine biological research in the Antarctic in the years to come. They will also help determine the need for and design of any successor to the BIOMASS program.

Toward a "More-Focused" Post-BIOMASS Program

A review of recent FIBEX and SIBEX results has shown that despite the large quantities of data collected, much remains to be done. At present, some of the deficiencies are being addressed by ongoing or proposed programs, these include:

International Target Strength Study

Definitive target strength experiments of *Euphausia superba* are recognized as being of utmost importance for making better use of both present and future acoustic data.

International Krill Physiology Project

Physiological studies of krill growth, energy requirements, and metabolic rates are extremely important for understanding the ecological relationships in the Southern Ocean. A workshop focusing on research needs, particularly the standardization of methodologies to improve the current low degree of comparability of results from different research groups, is mentioned under *Krill Physiology and Biochemistry*, above.

International Weddell Sea Winter Studies

The objective of these ongoing studies is to provide relevant information on the physical/chemical components of the marine ecosystem of the area in winter, in particular:

- to describe the physical/chemical factors governing the distribution, abundance, productivity and behavior of marine organisms, especially phytoplankton, zooplankton (including krill), and fishes;
- to describe the short- and long-term environmental fluctuations governing the biology of the organisms under the ice cover; and
- to describe the behavior of the penguins and seals in the pack-ice.

Both the Federal Republic of Germany and the U.S.A. (the latter, through its **Antarctic Marine Ecosystem Research in the Ice Edge Zone (AMERIEZ)** program) are presently involved in these winter studies.

Other "Spin-Off" Research Programs from the BIOMASS Program

These might include the following:

Krill biology and its relation to the environment. Krill biology is still a research field of high priority. Key topics that need to be addressed include:

- Growth and mortality in different areas
- Spawning success and recruitment mechanisms
- Stock separation and migration patterns
- Krill survival underneath the ice in winter.

All these topics should be viewed in relation to the biotic and abiotic environment of the krill. The Group of Specialists on Southern Ocean Ecosystems and Their Living Resources, at its meeting in Nikko, Japan in June 1982, posed 17 "Key Questions" (see BIOMASS Report Series No. 24, p. 25) regarding krill research, hoping the planners of SIBEX would address these. While some progress has been made during SIBEX, many of the questions are still awaiting attention.

Methodology for abundance estimates of krill. Solving the great uncertainties regarding target strength and net avoidance calls for concerted international action in areas of hydroacoustics and net sampling.

Research on other dominant components of the ecosystem. These components include fish, squid, and key predators, research on which has, to a large extent, been subordinated to krill research.

Modelling

Modelling is seen to be an important tool in resource evaluation. A whole ecosystem perspective is essential to the understanding and careful use of living resources in Antarctic waters, but it is not easy to develop this perspective from the usual starting point of observation of one particular element in the ecosystem. One method of tackling the work of understanding the whole ecosystem is the development of suitable models. They are particularly useful for ensuring a systematic approach to research and exploring the logical conclusion to certain hypotheses. Models also provide an ecologically meaningful framework for organizing, analyzing, and integrating data of different types and from various sources.

In state-of-the-art of ecosystem modelling, the process of model building may be more useful than model results. Objectives of Antarctic models are:*

1. Interaction among disciplines applied to Antarctic studies at both the conceptual and data analysis levels.
2. Focus for Antarctic research through organization of existing data and identification of information needs from an ecosystem perspective.
3. Descriptive ecology of the whole Southern Ocean at the level of interacting populations through dynamic simulation.
4. Feedback between model predictions and field and experimental research to refine both models and research programs.
5. Ultimate development of predictive model(s) of Southern Ocean biology useful for conservation of Antartic living resources.

Complementary Research Programs with CCAMLR

As mentioned before, the Scientific Committee of CCAMLR has the responsibility of providing information and management advice about the Southern Ocean ecosystem and its living resources. The necessary research cannot be handled by CCAMLR alone. There is need for cooperation between SCAR and its subsidiary bodies and CCAMLR on several key research activities. For instance, the proposed collaborative **International Studies of Krill Physiology and Biochemistry** currently being formulated (under SCAR/BIOMASS auspices) is an example of how SCAR/BIOMASS's expertise can be drawn upon to provide essential background information for the management-oriented activities of CCAMLR.

---

* See: Biological Investigations of Marine Antarctic Systems and Stocks, Vol. 1: Research Proposals (1977), S.Z. El-Sayed, editor, p. 9.

Those who are involved in BIOMASS view the role of BIOMASS, or any SCAR coordinated successor to the program, as providing assistance to and cooperation with CCAMLR. It is assumed that this policy of cooperation and assistance is a mutual one, with BIOMASS and CCAMLR each having unique strengths and resources. The BIOMASS community has developed a level of competence and expertise capable of advancing basic scientific understanding of the Antarctic marine ecosystem and can thus make a valuable contribution to CCAMLR in its mandate to conserve the living resources of the Antarctic within the context of the ecosystem.

As an example of this assistance and cooperation, CCAMLR will be able to draw upon the competence and expertise of the BIOMASS community in planning and carrying out its long-term ecosystem monitoring program designed to assess seasonal and interannual variability of the biological, chemical, and physical oceanographic parameters and processes at selected sites. Such a research effort would be of great interest to SCAR/SCOR, as well as CCAMLR.

The essential components of an ecosystem monitoring program are outlined in the report of the CCAMLR ad hoc **Working Group on Ecosystem Monitoring***. The Working Group has identified: the species targeted for research; the broad categories of parameters to be monitored for predator species (i.e., reproduction, growth and feeding behavior, abundance, and distribution); potential areas and sites for ecosystem monitoring (with special emphasis on Prydz Bay, Bransfield Strait, and South Georgia regions); and the hydrographic features to be investigated in relation to temporal and spatial scale effects on availability of prey to regional predator populations.

In planning future collaborative research activities between SCAR and CCAMLR, it is important to ensure that the research programs are not competing with each other, rather that they complement each other. Necessarily, CCAMLR must concentrate its efforts on directed research, while SCAR (and SCOR) must concentrate on basic research. To coordinate and maximize collabarative efforts, it would be desirable to have formal links between CCAMLR and SCAR.

---

* Report of the meeting of the ad hoc Working Group on Ecosystem Monitoring. Scientific Committee for the Conservation of Antarctic Marine Living Resources. Seattle, Washington, U.S.A., 6-11 May 1985.

Cooperative Research with Other International Programs

A fourth option that Antarctic investigators have is to join forces with ongoing or planned programs in the Southern Ocean. A few of these programs are listed below.

Antarctic Sea Ice Studies

The seasonal advance and decay of sea ice around the Antarctic continent, a unique physical feature of the region, plays a dominant role in determining the overall structure of this ecosystem. It is likely that interannual variability in this process has a significant impact on the recruitment success of Antarctic krill and perhaps other species.

The proposed ten-year program for an international collaborative study of the Antarctic Sea Ice Zone includes a biological component. The expertise and competence developed by scientists from the F.R.G., U.S.A., and other countries while pursuing their Weddell Sea Winter Studies should ensure that the new program will significantly contribute to a better understanding of the pack-ice ecosystem.

World Ocean Circulation Experiment (WOCE)

WOCE is an international program being coordinated under the SCOR/IOC Committee on Climatic Changes and the Ocean as a major marine mcience contribution to WMO/ICSU, **World Climate Research Programme.** The primary scientific objective of WOCE is ". . . to understand the general circulation of the global ocean well enough to be able to model its present state and predict its evolution in relation to long-term changes in the atmosphere."

Starting in 1987, WOCE will begin working on the first comprehensive global survey of physical properties of the oceans which it is expected to provide by 1995. The resulting data will be used to establish the first "global baseline" for long-term behavior of the ocean and to test computer models of the ocean circulation which are vitally needed to understand climate and to predict climate change.

The Southern Ocean has been identified for one of the three Core Projects that will have top priority in WOCE Goal 1 (i.e., developing models useful for predicting climate change and to collect the data necessary to test them).* It behooves Antarctic marine biologists to take advantage of this unique opportunity by joining forces with the physical and meteorological oceanographers in a collaborative effort to study the influence of the abiotic factors on the temporal and spatial variabilities of the major components of the Southern Ocean ecosystem.

EPILOGUE

In expressing its concern about the disbanding of the SCAR Group of Specialists on Southern Ocean Ecosystems and Their Living Resources and noting the possible vacuum created by the demise of the group, the SCAR Biology Working Group recommended to SCAR (at its XIX Meeting in June 1986) the establishment of a new **Group of Specialists on Southern Ocean Ecology.** The new group will identify important fields of research on Antarctic marine ecology and will propose cooperative studies, including multiship experiments. It will encourage and facilitate interdisciplinary studies in Antarctic marine ecosystems. It will develop Southern Ocean ecosystem studies through workshops and other activities. It will respond through SCAR to requests for scientific advice from the Antarctic Treaty as well as the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and other international organizations with interest in science, resources, and conservation in the Southern Ocean. Such advice will include possible impacts on marine ecosystems from fishing and potential mineral exploitation. The SCAR Executive approved the establishment of this Group and will seek SCOR sponsorship.

---

* Final Draft Scientific Plan World Ocean Circulation Experiment, December 1985.

LIST OF ACRONYMS

ACMRR	Advisory Committee on Marine Resources Research (of FAO)
ACR	SCAR Group of Specialists on Antarctic Climate Research
AMERIEZ	Antarctic Marine Ecosystem Research in the Ice Edge Zone
ASI	SCAR Group of Specialists on Antarctic Sea Ice
BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCCO	Committee on Climatic Change and the Ocean
FAO	Food and Agriculture Organization
FIBEX	First International BIOMASS Experiment
IABO	International Association for Biological Oceanography (of IUBS)
ICSU	International Council of Scientific Unions
IOC	Intergovernmental Oceanographic Commission
IUBS	International Union of Biological Sciences
IUCN	International Union for the Conservation of Nature and Natural Resources
IWC	International Whaling Commission
PG/SOC	Programme Group for the Southern Ocean
SCAR	Scientific Committee on Antarctic Research
SCOR	Scientific Committee on Oceanic Research
SIBEX	Second International BIOMASS Experiment
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
WOCE	World Ocean Circulation Experiment
WWF	World Wildlife Fund

DATE DUE

99999 Pam:574.5:(*80)
ELS

EL-SAYED, Sayed Z.
Biological studies of the
Southern Ocean

Borrower's Name	Date Due

99999 Pam:574.5:(*80)
ELS

EL-SAYED, Sayed Z.
Biological studies of the
Southern Ocean

Boreal Institute for Northern
Studies Library
CW 401 Bio Sci Bldg
The University of Alberta
Edmonton, AB Canada T6G 2E9

University of Alberta Library
0 1620 0329 6447